FIG. **13** shows an alternate embodiment that uses a single concave mirror **120** to redirect the point of convergence shown in FIGS. **11–12** to a more convenient position. In this case the single concave mirror **120** replaces the flat mirror **103** shown in FIG. **11** and the relay lens **110** shown in FIG. **12**.

A method of operating the AFM according to present invention will now be described. As shown in FIG. **4**, for example, a light beam is generated and then directed onto cantilever **14** using optical assembly **43** so that the light beam strikes substantially a fixed point on cantilever **14**, during movement of the scanning mechanism. The striking of substantially a fixed point is illustrated in FIG. **13**, where light beams **101** strike cantilever **14** while it is scanned across sample **13**. The light beam reflected from cantilever **14** (**47** in FIG. **4**) is received by position detector **16** which can detect deflections of cantilever **14**.

Also illustrated in FIG. **4** is the splitting of beam **44** using splitter **45** and the cut out in mounting member **42** to allow access of an optical microscope **46**, while in FIG. **7** the beam **68** is split using splitter **65** to direct a portion of the the beam **68** to a second position detector **66**.

FIG. **14** is a flowchart of a modification of the method of the invention where the location of the position detector is determined. First, in step **14-1**, the light beam reflected from the cantilever is measured while the scanner **12** is scanned over a full extent of its movement on a very flat surface or while actually not touching any sample. The change in position in the measured signal is then determined using position sensitive detector **16** (step **14-2**). The amount of change in this signal is a measure of the amount of "false deflection" being seen by the system. The position sensitive detector is then moved closer or further from the cantilever (along the optical axis of the reflected beam) and the scanning process repeated (step **14-3**) a desired number of times until these "false deflections" are minimized (step **144**). Position detector **16** is then placed at this location of minimum change (step **14-5**).

While the invention has been described with reference to several specific embodiments, those skilled in the art will be able to make various modifications to the described embodiments without departing from the true spirit and scope of the invention. For example, an AFM that scans using other optical elements such as prisms instead of lenses or mirrors, or other combinations of such elements to keep the laser focused on a scanning cantilever, is within the intended scope of the invention. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

Although what has been described is a contact AFM, where the stylus is in constant contact with the surface, the described invention can also be used in applications where the cantilever is oscillated, such as magnetic force microscopy (Martin and Wickeramasingle, Appl. Phys. Lett., 50, pg. 1455 (1987), Non-contact Topography, Durig et al, Phys. Rev. Lett., 53, p. 1045, (1988)) and as a jumping probe microscope where the stylus is repeatedly lifted off the surface during a scan (U.S. patent application Ser. No. 08/009,076), U.S. Pat. No. 5,266,801.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An atomic force microscope, comprising:

a scanning mechanism;

a light source;

a cantilever moved by said scanning mechanism so that said cantilever may be scanned over a fixed sample;

a stylus mounted on said cantilever;

an optical assembly comprising at least one steering lens, mounted on said scanning mechanism to guide a light beam emitted from said light source on the cantilever and to follow substantially a fixed point on said cantilever during movement of said scanning mechanism; and

a position detector which receives a reflected light beam from said cantilever and detects a deflection of said cantilever;

wherein said optical assembly comprises means for producing a point source of light between a fixed end and a free end of said scanning mechanism.

2. An atomic force microscope as recited in claim **1**, wherein said optical assembly steers said light beam onto a fixed point on said cantilever during a scan of said scanner of at least 30 μm.

3. An atomic force microscope as recited in claim **1**, wherein said scanning mechanism comprises a piezoelectric tube scanner and said optical assembly is mounted in said tube scanner.

4. An atomic force microscope as recited in claim **1**, wherein said scanning mechanism comprises at least one piezoelectric member, where said at least one piezoelectric member has an asymmetric cutout.

5. An atomic force microscope as recited in claim **1**, wherein said scanning mechanism comprises:

a piezoelectric tube scanner; and

a mounting member attached to said tube scanner and made of piezoelectric material, said cantilever being attached to said mounting member.

6. An atomic force microscope as recited in claim **3**, further comprising an optical mirror mounted in or in a vicinity of said tube scanner for receiving a light beam from said light source and directing said light beam to said optical assembly.

7. An atomic force microscope as recited in claim **1**, further comprising:

a second position detector; and

a beam splitter for directing a portion of light emitted from said light source onto said second position detector, wherein said beam splitter is mounted between said optical assembly and said cantilever;

wherein an output of the position detector is used to measure a motion of the scanner and cantilever in X and Y scan directions.

8. An atomic force microscope as recited in claim **1**, wherein:

said scanning mechanism comprises a scanner; and

said optical assembly comprises a focus lens, and a steering lens mounted in or alongside said scanner, said point source being formed between said focus lens and said steering lens.

9. An atomic force microscope as recited in the claim **8**, wherein said focus lens and said steering lens focus an image of said point source on said cantilever, during scanning motion of said cantilever.

10. An atomic force microscope as recited in claim **8**, further comprising an adjustment system for moving a position of the point source in a rough plane that is generally parallel to the sample, but maintaining an essentially fixed vertical position, keeping a vertical distance between said point source and said steering lens substantially constant, wherein said adjustment system allows the image to be moved onto said cantilever.

11. An atomic force microscope as recited in claim **8**, wherein a distance moved by said steering lens during